# The truth about TRIANGLES

## They're all the same... or are they?

new VOICES

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looks at the stereotyped image of the triangle and provides suggestions for teachers to expand children's perception of triangles.

Studies have shown that when most children are asked to identify shapes in particular triangles they identify the equilateral triangle in the standard position as the "true triangle" (Bassarear, 2005). In a world of clichés and generalisations, in the chaos of the classroom, the triangle in all its glory, with its many varied properties is being neglected. Thus an image of a standard, three equal-sided figure is being promoted as "the" triangle and the understanding and geometric conceptualisation of students is being limited to this overused and clichéd image. It is crucial in assisting students to reach their mathematical potential, that solid conceptual and theoretical understanding is laid in the primary years, as a foundation to be built upon. Consequently, primary teachers have the important role of assisting students to develop this foundation, through the experiences and metalanguage of the classroom, so that the truth about triangles can be understood. This article aims to provide an overview of background theory and research of the geometric nature of triangles and suggest some practical solutions for improving the understanding and experiences of students in the area of triangles and their properties.

In a study conducted by Bassarear (2005), a first grader was given a pattern of triangles (Figure 1), and asked to continue the pattern. After studying the pattern she said "triangle, triangle, wrong triangle, triangle, triangle, wrong triangle" (Bassarear, 2005, p. 520). This student, still at the early stages of under-

standing, shows a commonly held conception by young students that there is only one "true" triangle.

Pengelly (1999), suggests that commercial sets of shapes tend to promote only one type of triangle and unless children "experience a comprehensive collections of triangles of various sizes and shapes, they may think that all triangles resemble the proportions of those that are equilateral" (Pengelly, 1991, p. 2). However, before we can teach students about different types of triangles and their properties, it is crucial that we as teachers have a sound knowledge and understanding of this shape and how it is classified.

As shown in Figure 2, triangles can be classified in two ways, by the length of their sides or by their angles (Van Cleave, 1994, pp. 30–31). Triangles classified by the length of their sides, are either equilateral with all the sides of equal length, isosceles with two sides of equal length, or scalene with no sides of equal length (BOS, 2002, pp.194–199). Whereas, triangles classified by their angles, are either acute with all angles less than 90*, right-angled with one angle exactly 90º, or obtuse with one angle greater than 90º. So there is not just one special triangle. There are many types of triangles which are used in everyday life that do not fall into the category of equilateral, but are just as significant. However, it is important to remember that these classifications are just the basic starting point of triangle classification as some triangles can be classified by the length of their sides and their angles.

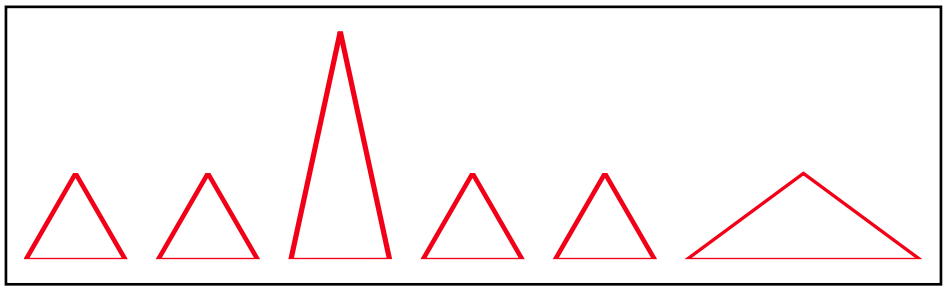


Figure 1. Continue the pattern (Bassarear, 2005, p. 520). What is the "true" triangle?

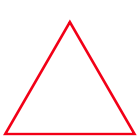
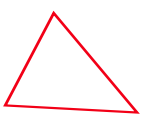
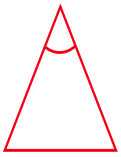
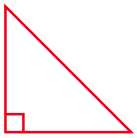
| Classification 1: Length of sides | | | Classification 2: Size of angles | | |
|---|---|---|---|---|---|
| Equilateral | Isosceles | Scalene | Acute | Right-angled | Obtuse |
|  |  |  |  |  |  |

Figure 2. Classification of Triangles (Van Cleave, 1994, pp. 30–31).

## Why is the truth important?

A mathematics syllabus is a crucial document because it guides our decisions and practices as teachers as it lays out the required content and skills that students are to develop over the time they spend at school. One of the main strands of the NSW mathematics syllabus is Space and Geometry (BOS, 2003, pp. 23, 117–137), this comprehensive section requires that by the time students finish primary, they should have achieved the following outcome; "SGS4.3 Classifies, constructs, and determines the properties of triangles and quadrilaterals" (BOS, 2002, p. 131). So if students are to achieve this level of understanding and competence, not only in the specific knowledge of triangles but all shapes, it is crucial that a solid geometric knowledge about things like spatial awareness, relationships between shapes, properties and characteristics of shapes is taught. The work of Bobis, Mulligan, Lowrie and Taplin (1999), emphasises the importance of challenging children to develop geometric knowledge through exploring their environment and being challenged to observe, analyse and represent their understanding. Often in classrooms, the "true" triangle syndrome comes

about because teachers fail to provide their students with experiences that go beyond convention. Experiences that challenge pre-determined ideas, and encourage students to develop problem solving skills than "simply recounting the number of sides or edges of a shape, or being shown one shape and [being told "this is a triangle]" (Bobis et al., 1999, p. 128).

## How can the truth be applied?

Obviously, explaining that there is not one true triangle is not enough. Providing students with interactive and educational experiences, that are varied and engaging, and that enable them to begin to connect mathematical concepts and ideas will assist learning.

There are many resources available to assist in providing these kinds of practical concrete based experiences needed to develop the concepts described in this article. On the Internet, two websites I recommend as sites students can use to experiment with the properties of triangles are:

- virtual manipulatives at:
  nlvm.usu.edu/en/nav/vlibrary.html
  a site where students can create different triangle shapes (congruent triangles) and measure their sides (geoboards).
- and the National Council of Teachers of Mathematics (NCTM) at:
  standards.nctm.org/document/eexamples/chap4/4.2
  a site with an online geoboard where students can electronically move rubber bands to create different shapes.

There are many books that provide worksheets and activities to assist with teaching the concepts behind triangles, such as *Triangles* (Pengelly, 1991), which provides a huge amount of reproducible blackline masters of many types of triangles, or *Geometry for Every Kid* (Van Cleaves, 1994), which has numerous interactive geometry activities, including a section dealing with the properties of triangles. These are just starting places, and as teachers it is important to assess all resources in relation to the dynamics of each individual classroom, so that the resources used assist the individual needs of students.

## The truth is out there!

This article was written to highlight an issue that could occur in the classroom. This information is meant to encourage and spur teachers into action to dispel the myth of a "true" triangle. There is more to the triangle family that just the equilateral triangle, in the same way there is more to the each polygon shape that simply the one that is conventionally used. As teachers, we have the opportunity with our students to change misconceptions and encourage new ideas, as mathematically concepts cannot be built upon if the foundation is not solid. The truth about triangles is now out there, encourage and inspire students to learn, do not be confined by convention but set free by truth.

## References

Bassarear, T. (2005). *Mathematics for Elementary School Teachers.* Boston: Houghton Mifflin Company.

Board of Studies NSW (2003). *Mathematics K–6 Syllabus.* Sydney: Author

Bobis, J., Mulligan, J., Lowrie, T. & Taplin, M. (1999). *Mathematics for Children: Challenging Children to Think Mathematically.* Sydney: Prentice Hall.

National Council for Teachers of Mathematics. *Principles and Standards for School Mathematics: Electronic Examples.* Accessed at: http://standards.nctm.org/document/eexamples/chap4/4.2/.

Pengelly, H. (1991). *Triangles.* Melbourne: Ashton Scholastic.

Troutman, A. & Litchenberg, B. (1987). *Mathematics A Good Begginning: Strategies for Teaching Children.* California: Brooks/Cole Publishing.

Utah State University. *National Library of Virtual Manipulatives for Interactive Mathematics: Geometry.* Accessed at: http://nlvm.usu.edu/en/nav/vlibrary.html.

VanCleaves, J. (1994). *Geometry for Every Kid.* Toronto: John Wiley & Sons.

Williams, E. & Shuard, H. (1994). *Primary Mathematics Today.* London: Addison Wesley Longman Limited.

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